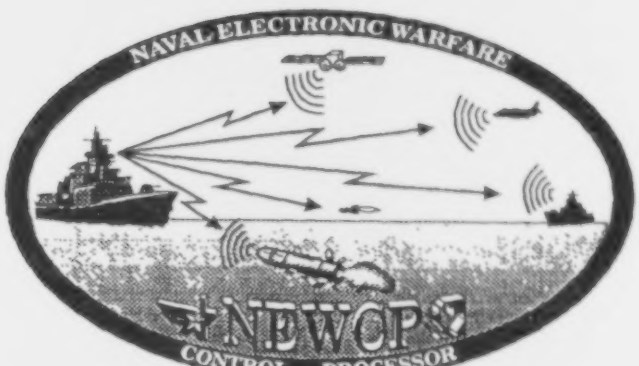
DREO CR 2000-024



The Integration Of
Electronic Warfare Assets On
Maritime Platforms
PHASE I

PRELIMINARY FUNCTIONAL REQUIREMENTS SPECIFICATION

SSC: W7714-2-9616

NOVEMBER 1993

Submitted to:

DREO, DND

Prepared by:

Lockheed Canada

1 Iber Road
Stittsville, Ontario
Canada
K2S 1E5

TABLE OF CONTENTS

PAGE

Table of Contents i
List of Figures ii

1 INTRODUCTION 1

2 NEWCP FUNCTIONAL REQUIREMENTS 8

2.1 Statement Of High Level Goals of the NEWCP 8
2.2 EW Battle Level Functional Requirements 9
2.3 EW Engagement Level Functional Requirements 11
2.4 EW Tactical Level Functional Requirements 13
2.5 EW Device Level Functional Requirements 17

3 CCS - NEWCP INFORMATION FLOW 27

3.1 CCS to NEWCP 27

3.2 NEWCP to CCS 29

4 PERFORMANCE CRITERIA 32

LIST OF FIGURES

PAGE

FIGURE 1 6
FIGURE 2 7

1 INTRODUCTION

The purpose of this document is to provide a set of functional requirements and related performance requirements for the Naval Electronic Warfare Control Processor (NEWCP).

Prior to the provision of actual requirements, fundamental goal(s) of the NEWCP are identified. These goals help to bound the problem of generating functional requirements.

Certain major elements of an eventual NEWCP design will not be represented in the list of goals. Although there is clearly a requirement for the NEWCP to have, for example, a sensor data fusion function, the fundamental goal of the NEWCP is not to fuse data. Therefore, this functional requirement will not be found in the list of fundamental goals.

The following material provides visibility into the methodology that was used in the generation of the functional requirements provided in this document.

The functional requirements specification serves to define what functions the NEWCP must perform. The NEWCP is required to perform a variety of functions in the specific context (or problem domain) of naval EW engagements. Accordingly, the FRS must ensure that requirements are generated that are directly relevant to this problem domain at its different levels of description. Furthermore, a particular function that the NEWCP must perform can be resolved into multiple layers, each of which describes the function at a different level of detail.

The principles described in the above paragraph are perhaps best illustrated by example. Consider the function "effectiveness assessment". The NEWCP will need to quantify the success / failure of EW engagements - requirements related to effectiveness assessment must address the problem domain. Therefore, there may be effectiveness assessment requirements at the level of the overall EW battle and somewhat different requirements at the level of the EW engagement of an individual threat.

In addition, the function "effectiveness assessment" can also be examined in terms of how it can be decomposed into a hierarchy of generic functionality at different levels of detail. The requirement to perform "effectiveness assessment" gives rise to a lower level requirement to compare an expected outcome to an observed outcome. Further decomposition is possible.

The two perspectives described above (i.e. the problem domain perspective and the functional decomposition perspective) are complementary and together they serve to elaborate NEWCP requirements.

Figure 1 provides a pictorial representation of the methodology for deriving NEWCP functional requirements. One of the horizontal axes represents the set of basic functions that the NEWCP will perform, functions such as effectiveness assessment and the management of uncertain information (UMS). The second horizontal axis represents the decomposition of these basic functions into hierarchical layers. As one proceeds "into" the cube along this axis, the basic functions are resolved into lower level functions. For example sensor data fusion (not explicitly shown in Figure 1) can be decomposed into data alignment, data correlation, as well as other sub-functions. This functional decomposition is represented pictorially by the different branch structures present within the cube. Finally, the vertical axis represents the different levels at which the EW problem domain can be described (EW Battle, EW Engagement, EW Tactical, and EW Device).

The EW Battle level of description addresses the entire EW combat scenario, involving issues associated with coordinating multiple EW engagements as well as (possibly) addressing such high level issues as fratricide prevention. The EW Engagement level of description focuses on issues related to the EW prosecution of a single threat. A prominent example of an EW Engagement level issue is the problem of implementing a layered EW defence approach. The EW Tactical level of description describes EW in terms of the need to achieve certain specific tactical goals when engaging threats. Such tactical objectives include avoidance, confusion, dilution, and seduction. Finally the EW Device level of description addresses EW in terms of how actual EW equipments are used as sources of important data as well as the effectors of EW actions. This resolution of the problem domain into four distinct layers of description is central to the development of functional requirements. For a more detailed elaboration of this four level model, the reader is advised to consult the proposal.

For obvious practical reasons, the functional requirements cannot actually be presented in a cube-like structure. The following guidelines will assist the reader in relating the actual format of presentation to the cube model:

(1) Functional requirements will be presented in four sets, representing the four levels of description associated with the problem domain. These four sets represent the vertical axis of the cube. The members of each set are labelled with an identifier of the form Bx for EW Battle level, Ex for EW Engagement level, Tx for EW Tactical level, and Dx for the EW Device level; where x is an integer.

(2) Within each of the sets described in item 1, a series of requirements will be provided. This group of n different requirements represents the n different basic functions for the problem domain set defined (e.g. B1 through B24 for the EW Battle level set).

(3) Visibility into the third axis of the cube, the decomposition axis, will be provided by the text of the individual requirements as described in item 2 above.

Having presented this model, it should be stated that for the purpose of this functional requirements specification, emphasis will be placed upon elaborating requirements in terms of the problem domain and the basic function perspectives. The decomposition of the basic functions, which will require a more comprehensive understanding of the problem domain, will be based upon the follow-on phases of the study, most notably the Effectiveness Assessment Techniques phase and the EW Deployment and Control phase.

A full elaboration of requirements in terms of the decomposition dimension will be accomplished more efficiently once a more detailed understanding of the EW management problem has been achieved. For example, it is not currently clear how best to decompose the effectiveness assessment function into lower level functions. Once a study has been made of effectiveness assessment techniques (under the second of the four project main tasks), an adequate knowledge base will be in place and such .. requirements may be generated more efficiently.

It is to be noted that the position of a requirement within the requirements structure, particularly its vertical position, is not indicative of the importance of the requirement nor of the ease / difficulty with which the requirement can be satisfied by a particular design.

With respect to the generation of functional requirements at the EW Device level, future CPF equipments (e.g. MFR) have not been addressed in this specification. However, sources of information concerning such equipments have recently been identified and the EW Device Level requirements will be updated as soon as possible.

In order to address the important issue of determining the data flow between the CCS and the NEWCP, a preliminary specification of such data flow is provided. In this preliminary specification, such material is provided primarily to give visibility into the proposed division of functionality between the CCS and the NEWCP (refer below). This data flow specification is not intended to be comprehensive nor highly detailed. It is recognized that the determination of the partitioning of functionality between the CCS and the NEWCP will be an evolutionary process. Accordingly, a detailed and comprehensive specification of data flow between the CCS and the NEWCP would be inappropriate at this time.

A major issue that needs to be addressed and resolved concerns the division of functionality between the CCS and the NEWCP. The NEWCP will not exist in a vacuum and defining its relationship to the CCS must be done relatively early on in the evolution of the design of this control processor. In principle, a variety of approaches can be taken, each conferring different functional responsibilities upon the NEWCP.

One approach that has merit is the approach of considering that the CCS interact with the NEWCP as if the latter were simply another weapon system. A schematic representation of this approach, placing the NEWCP in the context of the CPF

combat system, is provided at Figure 2. This approach seems to be quite natural since it appears to be the one that is most consistent with the existing CPF combat system philosophy. The structure of the existing CPF combat system is one where the CCS evaluates threats and assigns weapons to these threats. If the NEWCP is viewed as a weapon, then the CCS would designate targets to it and the NEWCP would select the optimal EW defence strategy. Of course, the actions of the NEWCP will always be subject to constraints as applied by the CCS.

For example, the CCS might elect to constrain the actions of the NEWCP within the context of a specific strategy involving the coordinated use of hardkill and softkill (EW) assets. In such a situation, the CCS may specifically request that the NEWCP decoy a threat to a certain general location at a particular time. The NEWCP is thus constrained in terms of the EW options it may undertake.

In addition, the NEWCP will have the capability of requesting services from the CCS in order to optimize EW weapons effectiveness. For example, the NEWCP may request that a STIR fire control radar acquire and track a specific target in order to perform measurements in support of EW effectiveness assessment.

Under the "NEWCP as a weapon" approach, the tasks of ranking threats, developing an overall defence strategy (possibly involving the coordinated use of hardkill and softkill weapons) remains under the purview of the CCS. By logical extension, the CCS would be responsible for assigning specific threats to the NEWCP for prosecution. The NEWCP, with its highly specialized embedded knowledge of EW, would be responsible for determining precisely how the set of threats designated to it by the CCS are to be engaged. It is worthy to note that combinations of EW assets may be selected by the NEWCP for use against particular threats.

The approach of considering the NEWCP to be effectively a weapon results in a relatively straightforward partitioning of some functions. For instance, it is fairly clear that it will be the CCS that determines which targets should be engaged by EW just as it also fairly clear that the NEWCP will be responsible for coordinating the deployment of multiple EW assets in the prosecution of a threat designated to it by the CCS.

There are other functions, however, for which the desired partitioning is not immediately clear. Consider, for example, the functions of sensor data fusion and tactical situation assessment. The determination of where these critical functions should be performed (i.e. CCS, NEWCP, or distributed across both) depends on a variety of factors including such implementation factors as processor speed and i/o rates.

It is understood that the partitioning of functionality between the CCS and the NEWCP needs to be resolved prior to the specification of a preliminary design. However, it is recommended that the final resolution of this issue be deferred pending the completion of tasks 2200 (Effectiveness Assessment) and 2300 (Deployment and Control).

Furthermore, it will be beneficial to receive input from interested DND personnel before proceeding further on this matter.

The following reference documents were used in the generation of this Preliminary Functional Requirements Specification:

A. "Threat and Scenario Review Working Paper": The Integration of Electronic Warfare Assets on Maritime Platforms - Phase 1; SSC W7714-2-9616;

B. "Equipment Study Working Paper (Volumes A and B)": The Integration of Electronic Warfare Assets on Maritime Platforms - Phase 1; SSC W7714-2-9616; and

C. "Proposal for the Integration of Electronic Warfare Assets on Maritime Platforms Phase 1".

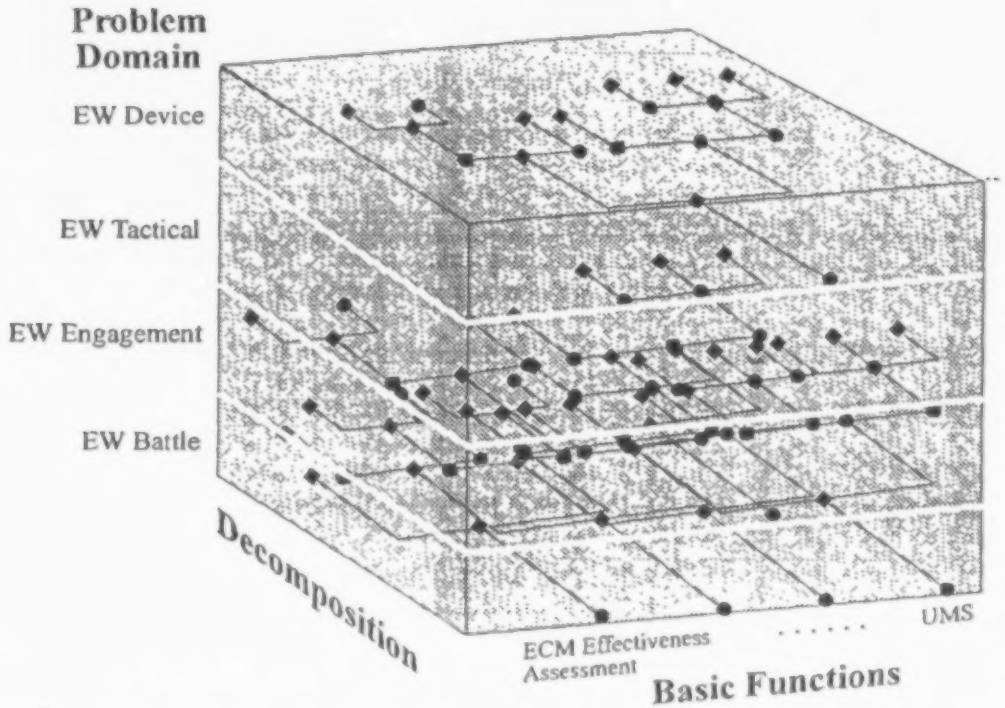
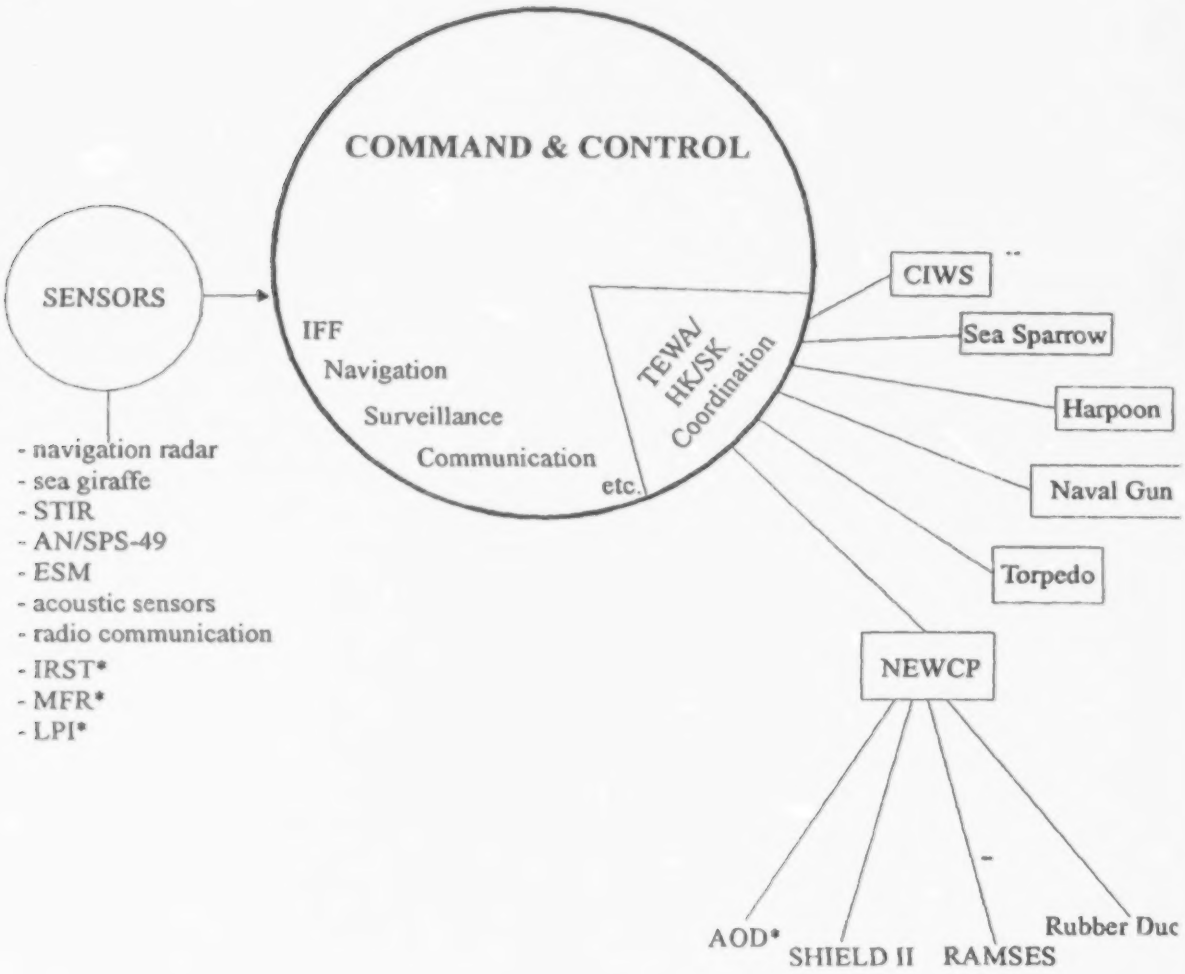

Problem Domain
EW Device
EW Tactical
EW Engagement
EW Battle
Decomposition
ECM Effectiveness Assessment
UMS
Basic Functions

FIGURE 1



* Future systems

FIGURE 2

2 NEWCP FUNCTIONAL REQUIREMENTS

2.1 Statement Of High Level Goals of the NEWCP

The following material is provided in order to formalize some of the basic goals to be met by a Naval Electronic Warfare Control Processor (NEWCP). Each goal is identified by an alphanumeric code of the form Zx where x is an integer.

Z1 The primary goal of the NEWCP is to support the maximization of the P_s (probability of survival) of the CPF and any assets for which it is responsible through the synergistic use of all softkill assets.

Z2 The NEWCP will deploy softkill assets in such a manner as to minimize the expenditure of EW resources;

Z3 The NEWCP will deploy EW assets in such a manner as to reduce the risk that softkill actions taken will directly lead to increased risk of damage to the CPF or any of its protected assets (e.g. beaconing of a threat onto a friendly asset);

Z4 The NEWCP will deploy assets in such a manner as to reduce the risk that softkill actions taken will indirectly lead to increased risk of damage to the CPF or any of its protected assets (this statement refers to the issue of "interference" as it is used in the proposal);

Z5 The NEWCP will deploy EW assets in such a manner as to prevent resource conflicts;

Z6 The activities of the NEWCP will be subject to the constraints imposed by doctrine / policy;

Z7 The NEWCP will, collaboratively with the CCS, exploit the potential for synergism between all CPF weapons systems;

Z8 The NEWCP will, collaboratively with the CCS, exploit the complementarity associated with the complete suite of CPF sensors;

Z9 The NEWCP will exploit, to the maximum extent possible, the potential for rendering EW - related assessments based on the complete combat environment context; and

Z10 The NEWCP will have the capability to dynamically modify its EW activities in response to changes in the combat environment. Furthermore, the NEWCP will account for the results of past engagements in the execution of its activities.

2.2 EW Battle Level Functional Requirements

The following are NEWCP functional requirements associated with the "EW Battle" level of description of the problem domain (as enumerated in section 1). Each requirement is identified by an alphanumeric code of the form Bx where x is an integer.

B1 The NEWCP will, subject to CCS control, cooperate with other EW platforms (e.g. other Force ships possibly equipped with an NEWCP) to ensure that optimal EW defence actions are undertaken.

B2 The NEWCP will coordinate the simultaneous prosecution of multiple threats, as designated by the CCS, that may attack over the course of a relatively short time interval (saturation attack);

B3 The NEWCP will dynamically modify elements of the EW defence actions it has undertaken for ship defence, as an attack sequence proceeds;

B4 The NEWCP will assess the effectiveness of the EW defence actions that it has undertaken. This assessment will be performed as the EW battle proceeds and serves to characterize the success / failure of the EW battle as a whole;

B5 The NEWCP will, collaboratively with the CCS, perform prioritization of assigned threats;

B6 The NEWCP will take advantage of all potential means for anticipating attacks in its defence strategies. In this regard, the following events (representative list) may serve as cues that an attack is imminent:

- Momentary detection of a targeting radar; and
- Detection of a radar altimeter.

B7 The NEWCP and CCS will together provide the capability of predicting / minimising possible fratricide risks associated with the implementation of a specific EW Battle plan;

B8 The NEWCP and CCS will together provide the capability of predicting / minimising the resource depletion effects associated with the implementation of a particular EW Battle plan;

B9 The NEWCP and CCS will together provide the capability of predicting / minimising the possibility of interference associated with the implementation of a particular EW Battle plan;

B10 The NEWCP will undertake EW Battle actions in such a manner as to minimize the problem of EW resource conflict;

B11 The NEWCP will respond to CCS originated commands and accept data as provided by the CCS. CCS commands may include weapons orders (e.g. order to use ECM in a specific way in order to support CCS hardkill / softkill coordination strategies), constraints, threat priority information, etc.;

B12 The NEWCP will provide information and recommendations to the CCS. Examples include the following:

- ECM resource availability;
- ECM effectiveness assessments; and
- Requests for ship manoeuvres;

B13 The NEWCP and CCS will have the collective capability of generating a comprehensive tactical picture. The NEWCP will contribute to this tactical picture by integrating multiple independent observations / lower level assessments;

B14 The NEWCP will apply appropriate constraints (e.g. temporal, spatial, etc.) in the execution of its EW Battle actions;

B15 In support of the generation of an EW Battle plan, the NEWCP will account for the EM emissions of all hostile platforms (e.g. targeting radars, etc.);

B16 In support of the generation of an EW battle plan, the NEWCP will account for the movements and the EM emissions of all friendly platforms;

B17 The NEWCP will have the capability of predicting the effectiveness of EW Battle plans that it has the option of undertaking;

B18 The NEWCP will have the ability to "learn" (i.e. update its database of EW battle strategies) from the results of past EW battles;

B19 The NEWCP will, subject to CCS approval, have the capability of cueing CPF sensors (e.g. to support the development of a comprehensive tactical picture);

B20 The NEWCP will make decisions and perform evaluations in the context of an EW Battle level problem domain that is characterized by both incomplete and imprecise information;

B21 The NEWCP will support operator input to the execution of NEWCP activities. Such inputs may include the provision of "override" commands and the introduction of new intelligence information into the NEWCP;

B22 The NEWCP will provide the operator with visibility into its EW battle activities (e.g. indication of ECM actions undertaken); and

B23 The NEWCP will generate its tactical picture of the EW battle by integrating information from a variety of CPF sensors.

2.3 EW Engagement Level Functional Requirements

The following are NEWCP functional requirements associated with the "EW Engagement" level of description of the problem domain (as enumerated in section 1). Each requirement is identified by an alphanumeric code of the form Ex where x is an integer.

E1 The NEWCP will perform real-time effectiveness assessment related to specific [EW weapon-threat] engagements. Furthermore, effectiveness assessments will be tailored to attributes of modern threats;

E2 The NEWCP will be capable of engaging long, medium, and short range threats;

E3 The NEWCP will be capable of engaging threat that originate from subsurface, surface, and air environments;

E4 The NEWCP will implement a layered EW defence strategy;

E5 Within the context of a layered EW defence strategy, the NEWCP will anticipate the requirement to implement an inner defence layer before the threat actually enters that layer;

E6 The NEWCP will provide the capability of engaging threats that employ active sensors to home on their target;

E7 The NEWCP will provide the capability of engaging threats that employ passive sensors to home on their target;

E8 The NEWCP will implement coordinated and synergistic strategies for the deployment of EW weapons;

E9 The NEWCP will support the dynamic modification of a particular EW tactic (e.g. suspend ineffective tactic);

E10 The NEWCP will support the EW engagement of threats as early in an engagement as possible;

E11 The NEWCP will, collaboratively with the CCS, have the capability of generating information, descriptive of a specific threat engagement by EW, that can support a determination of whether a fratricide risk exists associated with the EW engagement of that threat;

E12 The NEWCP will, collaboratively with the CCS, have the capability of predicting / minimising the resource depletion effects associated with the EW engagement of a particular threat;

E13 The NEWCP will, collaboratively with the CCS, have the capability of predicting / minimising the possibility of interference associated with the EW engagement of a particular threat;

E14 The NEWCP will undertake engagements in such a manner as to minimize the problem of EW resource conflict (i.e. the NEWCP will account for limited CPF EW resources);

E15 The NEWCP will undertake threat-specific EW engagements in such a manner as to support other ship warfare activities (e.g. as directed by the CCS, decoy a threat to a specific location in order to support hardkill prosecution);

E16 The NEWCP will apply appropriate constraints (e.g. temporal, spatial, etc.) in the execution of its EW engagement actions;

E17 Within the context of the execution of a threat EW engagement, the NEWCP will have the capability of accounting for the EM emissions of the threat;

E18 Within the context of the execution of a threat EW engagement, the NEWCP will account for the EM emissions of the friendly weapons systems;

E19 The NEWCP will have the capability of supporting threat identification;

E20 The NEWCP will, collaboratively with the CCS, develop a set of metrics that describe the threat specifically in terms of the level of threat it poses to CPF and associated resources. Examples of such metrics include:

- Predicted time to intercept;
- Hostile kinematic behaviour (e.g. low predicted CPA of threat to CPF);
- Hostile threat emissions (e.g. track mode);

- Threat Identity; and
- etc.

E21 The NEWCP will have the capability of predicting the effectiveness of threat-specific EW weapons actions it has the option of undertaking;

E22 In its generation of EW engagement options, the NEWCP will use knowledge of the results of past engagements;

E23 The NEWCP will have the capability of generating a cueing request for CPF sensors in specific support of the EW engagement of a particular threat (e.g. cue sensor to provide more comprehensive data on threat kinematics);

E24 The NEWCP will make decisions and perform evaluations in the context of an EW engagement level problem domain that is characterized by both incomplete and imprecise information; and

E25 The NEWCP will, collaboratively with the CCS, generate a tactical picture of the threat EW engagement by integrating information from a variety of sensors.

2.4 EW Tactical Level Functional Requirements

The following are NEWCP functional requirements associated with the "EW Tactical" level of description of the problem domain (as enumerated in section 1). Each requirement is identified by an alphanumeric code of the form Tx where x is an integer.

T1 The NEWCP will, for the purposes of effectiveness assessment, detect / characterize changes in the trajectories of targets;

T2 The NEWCP will, for the purposes of effectiveness assessment, have the capability of detecting that a threat radar (that had previously been illuminating the ship) is no longer illuminating the ship (over an extended period of time (lost / kill condition);

T3 The NEWCP will, for the purposes of effectiveness assessment, have the capability of detecting that a jog event has occurred. A jog event occurs whenever a sudden drop in received power is observed from a threat that had been previously illuminating the ship in a manner consistent with tracking activity;

T4 The NEWCP will, for the purposes of effectiveness assessment, have the capability of determining that the threat has altered its radar state (examples of radar state: search, acquisition, track);

T5 The NEWCP will implement ECM whose purpose is avoidance: to prevent detection by targeting radars;

T6 The NEWCP will implement ECM whose purpose is confusion: to avoid acquisition by a hostile launch platform radar;

T7 The NEWCP will implement ECM whose purpose is dilution: to counter the threat seeker's search or acquisition radar;

T8 The NEWCP will implement ECM whose purpose is seduction: to seduce the threat seeker's tracking radar away from a protected asset;

T9 When detailed information about threat attributes is available, the NEWCP will generally implement a "surgical" countermeasure - one whose attributes are tailored to the characteristics of the threat;

T10 When limited information about threat attributes is available, the NEWCP will generally implement a "generic" countermeasure - one whose attributes take advantage of what is known about the threat but yet are also sufficiently generic to be effective given what is not known about the threat;

T11 When no information about threat attributes is available, the NEWCP will generally implement a "robust" countermeasure - one whose attributes will have some value against all types of threats that can be reasonably be anticipated;

T12 The NEWCP will implement countermeasures whose purpose is to induce breaklocks and or other radar state transitions in the threat seeker;

T13 The NEWCP will implement ECM whose purpose is to induce threat trajectory changes;

T14 The NEWCP will ensure that the predicted threat miss-distance produced by a countermeasure will, as a minimum, exceed the lethality radius associated with the threat (fusing technology dependent);

T15 The NEWCP will exploit the possibility of detonating missile warheads through the transmission of appropriate waveforms;

T16 In order to achieve the various tactical objectives (e.g. avoidance, confusion, dilution, and seduction), the NEWCP will have the capability to deploy multiple ECM options in a coordinated and synergistic manner;

T17 The NEWCP will support the dynamic modification of an ECM technique;

T18 The NEWCP will, collaboratively with the CCS, provide as comprehensive a characterization as possible of the kinematic parameters associated with a particular target;

T19 The NEWCP will provide as comprehensive a characterization as possible of the emissions behaviour (e.g. radar emissions, IR emissions) associated with a particular target;

T20 The NEWCP will use any available information it may have (possibly received from the CCS) descriptive of specific threat characteristics and attributes, including but not necessarily limited to the following, in the generation of ECM options:

- IR signatures;
- EM signature (e.g. PRI, frequency, etc.)
- Trajectory (including manoeuvres);
- Low observables;
- EPM capabilities; and
- WARM modes.

T21 The NEWCP will provide the capability to resolve true targets from false targets created by multipath or ownship chaff clouds;

T22 The NEWCP will, collaboratively with the CCS, have the capability of determining the positions of all off-board ECM assets deployed;

T23 The NEWCP will, collaboratively with the CCS, have the capability of determining the operating states (e.g. chaff bloomed / decayed) of deployed off-board ECM assets;

T24 The NEWCP will, collaboratively with the CCS, have the capability of generating information, descriptive of a specific ECM prosecution, that can support a determination of whether a fratricide risk exists associated with the implementation of that countermeasure;

T25 The NEWCP will, collaboratively with the CCS, have the capability of preventing / minimising spectral interference between active ECM systems (RAMSES) and ship sensors (including CANEWS);

T26 The NEWCP will, collaboratively with the CCS, have the capability of preventing / minimising spectral interference between active ECM systems (RAMSES) and ship communications systems (e.g. SATCOM);

T27 The NEWCP will have the capability of preventing / minimising spatial interference between ECM systems (e.g. chaff obscuration of RAMSES);

T28 The NEWCP will undertake ECM in such a manner as to minimize the problem of EW resource conflict (i.e. the NEWCP will account for limited CPF EW resources);

T29 The NEWCP will have the capability of predicting / minimising the EW resource depletion effects associated with a particular ECM option;

T30 The NEWCP will implement specific ECM, as dictated by the CCS, to specifically support other ship warfare activities (e.g. decoy a threat to a specific location in order to support hardkill prosecution);

T31 The NEWCP will request a change to ship heading and / or speed in order to accommodate various ECM (e.g. heading change for chaff deployment);

T32 The NEWCP will possess knowledge of the expected threat responses associated with various softkill countermeasures;

T33 When formulating tactical options, the NEWCP will account for spatial, spectral, and temporal constraints;

T34 To the maximum extent possible, the NEWCP will have the ability to discriminate between pre-programmed threat manoeuvres and changes in threat trajectory that are consistent with a successful prosecution by softkill;

T35 The NEWCP will, in the absence of definitive knowledge of threat EPM capabilities, use hypotheses about such capabilities in creating countermeasures options;

T36 The NEWCP will have the capability of inferring EPM characteristics of a threat by measuring the response of the threat to countermeasures that have already been deployed;

T37 In support of countermeasures deployment, the NEWCP will, collaboratively with the CCS, fuse data from the complete suite of CPF sensors;

T38 The NEWCP will incorporate a knowledge base of CPF sensor capabilities and limitations;

T39 The NEWCP will incorporate a knowledge base of CPF ECM capabilities and limitations;

T40 The NEWCP will incorporate a knowledge base providing countermeasure options that correspond to specific threat characteristics, attributes, and parameters;

T41 The NEWCP will incorporate a knowledge base of effectiveness assessment parameters (e.g. signal characteristics that define a "jog" event, etc);

T42 In support of the implementation of ECM techniques, the NEWCP will use relevant environmental information (provided by the CCS) in the execution of its activities:

- Sea State;
- Wind speed and direction; and
- Precipitation state.

T43 The NEWCP will have the capability of predicting the effectiveness of threat-specific softkill weapons actions it has the option of undertaking;

T44 In its generation of ECM options, the NEWCP will use knowledge of the results of past ECM prosecutions;

T45 In support of specific ECM implementations, the NEWCP will have the capability of requesting that the CCS cue various CPF sensors; and

T46 The NEWCP will make EW decisions and perform EW evaluations in the context of a tactical level problem domain that is characterized by both incomplete and imprecise information.

2.5 EW Device Level Functional Requirements

The following are NEWCP functional requirements associated with the "EW Device" level of description of the problem domain (as enumerated in section 1). Each requirement is identified by an alphanumeric code of the form Dx where x is an integer.

It is important to underscore that CPF equipment (particularly sensors) can be viewed as resources that the NEWCP can exploit in order to meet requirements already enumerated at the EW Battle, EW Engagement, and EW Tactical levels of problem domain description. It is therefore appropriate that NEWCP requirements be defined that specify the functionality of the interaction of the NEWCP with such equipment.

Most of the device level requirements presented are relevant to specific CPF equipments. Accordingly, many requirements are presented in equipment specific blocks.

For amplifying details concerning the CPF equipments, please consult Ref. B.

D1 The NEWCP will receive, possibly via the CCS, contact range, range rate, azimuth, and azimuth rate data from the SPS-49 surveillance radar;

D2 The NEWCP will have the capability to generate a recommendation concerning the elevation coverage mode of operation of the SPS-49 surveillance radar (nominal mode / upspot mode);

D3 The NEWCP will have access to information concerning the SPS-49 surveillance radar elevation coverage mode of operation (nominal mode / upspot mode);

D4 The NEWCP will have the capability to generate a recommendation concerning the range mode of operation of the SPS-49 surveillance radar (nominal mode / anti-chaff mode);

D5 The NEWCP will have access to information concerning the SPS-49 surveillance radar range mode of operation (nominal mode / anti-chaff mode);

D6 The NEWCP will have access to track quality descriptors as provided by the SPS-49 surveillance radar;

D7 The NEWCP will have access to jammer track data (including signal amplitude information) generated by the SPS-49 surveillance radar;

D8 The NEWCP will have access to information concerning sectors into which the SPS-49 surveillance radar is prohibited from radiating;

D9 The NEWCP will have a knowledge base of the following (representative) SPS-49 surveillance radar parameters / information:

- Frequencies of operation;
- Range / elevation detection performance profile (nominal and upspot modes);
- Range measurement accuracy; and
- Azimuth measurement accuracy.

D10 The NEWCP will receive, possibly via the CCS, contact range, range rate, azimuth, and azimuth rate data from the Sea Giraffe surveillance radar;

D11 The NEWCP will have the capability to generate a recommendation concerning the beam pattern mode of operation of the Sea Giraffe surveillance radar;

D12 The NEWCP will have access to information concerning the Sea Giraffe surveillance radar beam pattern mode of operation (beam sequence);

D13 The NEWCP will have the capability to generate a recommendation concerning the range mode of operation of the Sea Giraffe surveillance radar (nominal mode / anti-chaff mode);

D14 The NEWCP will have access to information concerning the Sea Giraffe surveillance radar range mode of operation (nominal mode / anti-chaff mode);

D15 The NEWCP will have access to track quality descriptors as provided by the Sea Giraffe surveillance radar;

D16 The NEWCP will have access to jammer track data (including signal amplitude information) generated by the Sea Giraffe surveillance radar;

D17 The NEWCP will have access to information concerning sectors into which the Sea Giraffe surveillance radar is prohibited from radiating;

D18 The NEWCP will have a knowledge base of the following (representative) Sea Giraffe surveillance radar parameters / information:

- Frequencies of operation;
- Range / elevation detection performance profile (for multiple Sea Giraffe beams);
- Range measurement accuracy; and
- Azimuth measurement accuracy.

D19 The NEWCP will receive, possibly via the CCS, target range, range rate, azimuth, azimuth rate, elevation, and elevation rate data from the STIR fire control radar;

D20 The NEWCP will have the capability to generate a recommendation concerning the mode of operation of the STIR fire control radar (e.g. horizon search mode);

D21 The NEWCP will have access to information concerning the mode of operation of the STIR fire control radar (e.g. horizon search mode);

D22 The NEWCP will have the capability to generate a recommendation concerning the range mode of operation of the STIR fire control radar (high PRF mode / low PRF mode);

D23 The NEWCP will have access to information concerning the STIR fire control radar range mode of operation (high PRF mode / low PRF mode);

D24 The NEWCP will have access to tracking status (e.g. autofollow, generative, etc) information from the STIR fire control radar. This information allows the NEWCP to determine the quality of STIR track data;

D25 The NEWCP will have access to STIR fire control radar result assessment data (associated with hardkill engagements);

D26 The NEWCP will have access to information concerning noise and deception jammers that have been detected by the STIR fire control radar;

D27 The NEWCP will have the capability to generate a recommendation that the STIR be cued in order to improve the NEWCP's knowledge of a target;

D28 The NEWCP will have a knowledge base of the following (representative) STIR fire control radar parameters / information:

- Frequencies of operation;
- Minimum / maximum target tracking elevation limits;
- Blind zones;
- Range measurement accuracy; and
- Azimuth measurement accuracy.

D29 The NEWCP will receive, possibly via the CCS, target azimuth information from the CIWS tracking radar;

D30 The NEWCP will have access to information concerning J band jammers that have been detected by the CIWS;

D31 The NEWCP will receive, possibly via the CCS, target range, target azimuth, and target identity information from the AN/SQS-505 Hull Mounted Sonar (HMS);

D32 The NEWCP will receive, possibly via the CCS, target range, target azimuth, and target identity information from the Sonobuoy Processing System (SPS);

D33 The NEWCP will have the capability of providing the RAMSES jammer with a "JAM" designation. As a minimum, the NEWCP will provide the RAMSES with an azimuth sector. Other possible parameters in the designation can include the following:

- Elevation sector;
- "Window" of PRF values;
- "Window" of pulse width values;
- "Window" of frequency values;
- expected amplitude level;
- emitter number; and
- engagement priority.

D34 In order to reduce reaction times for new or unknown emitters, the NEWCP will provide the RAMSES with a special designation that includes, in addition to the parameters described in item D33, a reference to the jam command table and either a reference to the jam parameter table, or a set of designated jam parameters;

D35 In support of the designation command described in item D33, the NEWCP will need to have a detailed knowledge of the contents of the RAMSES threat store database;

D36 In order to optimize ECM effectiveness in a multi-threat engagement, the NEWCP must provide RAMSES with multiple pointers to the jam command table to account for primary, secondary, and possibly tertiary response priorities. Please refer to item D34 for information concerning the requirement for the NEWCP to provide RAMSES with a special designation;

D37 The NEWCP will have access to RAMSES result assessment information. The output of the RAMSES result assessment function will be one of the following:

- Jog;
- Kill; and
- Target Lost.

D38 The NEWCP will have the capability of cueing RAMSES by issuing a TRACK command to the jammer. Upon receipt of this command, the RAMSES jammer initiates acquisition and tracking functions;

D39 The NEWCP will have the capability of issuing a JAM IMMEDIATE command to RAMSES. Upon receipt of this command, RAMSES initiates predefined noise jamming employing the current transmit antenna azimuth, elevation, and polarization;

D40 The NEWCP will have the capability of terminating RAMSES jamming activity by issuing a BREAK command;

D41 The NEWCP will have access to information specifying RAMSES antennae commanded positions;

D42 The NEWCP will have access to information specifying status of each RAMSES jam channel;

D43 For each target being tracked, the NEWCP will have access to RAMSES information concerning target identity and measured parameters;

D44 The NEWCP will have access to RAMSES system diagnostic and status messages;

D45 The NEWCP will ensure that the operation of the RAMSES system will be subject to the following types of constraints:

- temporal;
- spatial; and
- spectral.

D46 The NEWCP will have a knowledge base of the following (representative) RAMSES parameters / information:

- Frequency coverage;
- Characteristics of radars subject to RAMSES prosecution (e.g. scan types, PRF ranges, pulse width ranges, etc);
- Sensitivity;
- Elevation limitations;
- Blind zones;
- Maximum target loading;
- Menu of RAMSES ECM techniques; and
- Response time.

D47 The NEWCP will have the capability of providing SHIELD with an engagement order. As a minimum, the NEWCP will provide SHIELD with relative threat bearing and time to impact. Other possible parameters in the designation can include the following:

- Decoy type (chaff or IR flare);
- Decoy launch direction (azimuth);
- Decoy mode (seduction / centroid, distraction, seduction / dump); and
- Fire command.

D48 The NEWCP will have access to SHIELD system status information (Ready / Loading);

D49 The NEWCP will have access to SHIELD system mode information (Automatic, Semi-Automatic, Manual, Local, Test);

D50 The NEWCP will have access to SHIELD information providing the number and type of SHIELD decoys fired;

D51 The NEWCP will have access to SHIELD information concerning SHIELD decoy location (range, azimuth);

D52 The NEWCP will have access to SHIELD recommendation for ship course and speed;

D53 The NEWCP will monitor the inventory level of chaff rounds;

D54 The NEWCP will monitor the inventory level of IR flare rounds;

D55 The NEWCP will ensure that the operation of the SHIELD system will be subject to the following constraints:

- temporal;
- spatial; and
- spectral.

D56 The NEWCP will have a knowledge base of the following (representative) SHIELD parameters / information:

- launcher(s) bearing and elevation;
- Tactical modes (seduction / centroid, distraction, seduction / dump);
- Characteristics of threats subject to prosecution by SHIELD (e.g. radar guided from 8 - 18 GHz);
- Fusing time;
- Munition trajectory;
- Maximum RCS;
- Bloom time;
- Persistence;
- Deployment time;
- IR flare radiant intensity;

- IR flares spectral emissions characteristics; and
- IR flares nominal sink rate (parachute deployment).

D57 The NEWCP will have access to emitter fundamental parameters as measured by CANEWS. Emitter fundamental parameters provided include:

- Emitter bearing;
- Emitter PRF;
- Emitter average frequency;
- Emitter pulse width;
- Scan type; and
- Scan period;

D58 The NEWCP will have access to CANEWS emitter identity information. Identity information includes:

- Emitter threat classification;
- Emitter principal identity; and
- Emitter principal identity confidence factor.

D59 The NEWCP will have access to higher order emitter characteristics as determined by CANEWS:

- Indication of emitter PRF jitter;
- Indication of emitter FMOP;
- Indication of emitter frequency diversity; and
- Indication of emitter frequency agility.

D60 Subject to necessary CANEWS modification, the NEWCP will have access to CANEWS pulse descriptor words for individual emitters. This would provide the NEWCP to monitor signal amplitudes in support of jog detection;

D61 Subject to necessary CANEWS modification, the NEWCP will have the capability of cueing the CANEWS in order to perform scan analysis;

D62 The NEWCP will have a knowledge base of the following (representative) CANEWS parameters / information:

- Frequency coverage;
- Characteristics of threats subject to CANEWS prosecution (e.g. range of pulse widths allowable);
- Sensitivity;

- Angle and signal attributes measurement accuracies;
- Elevation limitations;
- Emitter loading limitations; and
- Response time.

IMPORTANT NOTE:

The functionality represented by items D63 - D67 inclusive may not necessarily reside within the NEWCP. This functionality may instead reside completely within the CCS or the functionality may be distributed between the CCS and the NEWCP. Whatever the case may be, items D63 - D67 incorporate functions that need to be performed in order to support EW operations.

D63 The NEWCP will receive target data from non-CPF sensors via the Command and Control System. Such target data includes that derived from the use of satellites;

D64 The NEWCP will combine information from a variety of sensors, possibly via the CCS, in order to render target kinematics and classification information (Sensor Data Fusion function);

D65 Track information from different CPF sensors will undergo an alignment function whereby all measurements are converted to a common spatial and temporal reference frame;

D66 Track information (kinematics and attribute data) from different CPF sensors will be correlated to obtain the most comprehensive yet least redundant characterization of each target in the environment;

D67 Track information will undergo a filtering / prediction function whereby estimates of the position of each target will be generated;

D68 The NEWCP will have the following information embedded within it:

- Ownship / asset capabilities and limitations;
- Library of threat characteristics;
- Knowledge base of ownship ECM capabilities;

- Information providing countermeasure options as a function of what is known about the threat; and

- Archetypical descriptions of events with effectiveness assessment content (e.g. jog descriptions).

D69 The NEWCP will have access to CCS tactical information (possibly) relevant to NEWCP activities (e.g. threat rankings as determined by CCS).

3 CCS - NEWCP INFORMATION FLOW

The following material provides a preliminary specification of the data flow between the Command and Control System and the NEWCP. The data flow, specified at a relatively high level of description, is provided to assist in the problem of resolving the division of responsibility between the CCS and the NEWCP with respect to EW operations. The material provided in this section is to be considered as preliminary - it may change as efforts to specify the respective roles of the CCS and the NEWCP proceed.

3.1 CCS to NEWCP

▸ Constraints Regarding EW Operations

The CCS will have the capability of limiting the activities of the NEWCP in order to ensure that overall ship combat objectives are met. There are a variety of command and control level objectives that may require that constraints be imposed upon the NEWCP. Constraints may applied to avoid interference (e.g. chaff physically obscuring the line of sight of the STIR fire control radar), reduce the possibility of fratricide, and to minimize resource depletion.

The types of constraints that may be applied may be categorized as follows:

- Spatial;
- Spectral;
- Temporal; and
- Asset Utilization.

Note that constraints from different categories may be applied to the NEWCP. For instance, the CCS may not want chaff (restriction on asset utilization) to be deployed in a certain direction (restriction on spatial location).

▸ Threat Designation

The CCS establishes threat priority and determines which threats should be prosecuted using EW resources. Once such a determination has been made, the CCS must designate such threats to the NEWCP. The designation itself should include the following information:

- Threat Priority

The characterization of the threat in terms of a priority ranking accomplishes two goals: First, if multiple threats are designated to the

NEWCP, the threat priority serves to provide a list of threats for engagement, ordered according to priority. Second, for each threat in such an ordered list, a quantification of threat priority is provided. Where a single threat is designated to the NEWCP, this quantification of priority serves as a mechanism to inform the NEWCP of the criticality associated with the successful engagement of the threat.

- Engagement Zone

In order to implement a variety of tactical options, including the coordinated use of softkill and hardkill weapons, the CCS may require that the threat be engaged within a specific zone of space surrounding the ship. For example, the CCS may wish to attempt to decoy the threat while it is at relatively large range, and then prosecute the threat with hardkill weapons at shorter ranges, should the softkill engagement prove ineffectual. In this case, the threat designation to the NEWCP may indicate that the NEWCP should provide softkill prosecution that will be effective before the threat range drops below 15 km. The requirement for a specification of an engagement zone arises primarily from the use of layered AAW defence strategies.

- Predicted Effectiveness Request

The CCS may request that the NEWCP provide some measure of the predicted success of the EW engagements it is planning to undertake. This metric may be in the form of a "probability of softkill" number associated with each threat - EW weapon pair.

- Command and Control System Tactical Situation Assessment

CCS TSA information represents the tactical picture that has been compiled by the CCS. Elements of this tactical picture include the positions and speeds of all platforms involved in the engagement. Possible platforms include ships, aircraft, missiles, submarines, and satellites. Both friendly and hostile platforms are represented by the tactical situation assessment.

- Meterological Information

In order to properly execute its functions, the NEWCP requires that the CCS provide it with meteorological data that includes, but is not limited to, the following:

- wind direction and speed;
- sea state;
- precipitation;

▸ Threat Information

If possible, the CCS will provide the NEWCP with threat information to supplement that provided via the tactical situation assessment (refer above). Supplementary threat information includes, but is not limited to, the following:

- attributes (e.g. PRF);
- Identity; and
- Mode of Operation (e.g. search / track).

▸ Fleet EWCP Architecture

It is conceivable that there will be a requirement for a particular NEWCP to collaborate with other NEWCPs in the prosecution of a threat. This will be the case where cooperative jamming techniques such as "blinking" are employed. It is possible that, in the context of a fleet, a particular NEWCP may serve to coordinate the activities of other NEWCPs.

3.2 NEWCP to CCS

▸ Threat Engageability

This term is intended to represent the prediction of effectiveness that has been generated by the NEWCP in response to a CCS request to engage a particular threat. There may be several pieces of information associated with this predicted effectiveness including the probability of target softkill and the expected time to accomplish the target softkill.

▸ EW Resource Availability

The NEWCP will provide the CCS with information describing which EW resources are currently available.

- EW Tactical Situation Assessment

EW TSA information represents the tactical picture that has been compiled by the NEWCP. Elements of this tactical picture includes information descriptive of the disposition of ownship EW assets (e.g. position of asset, operating state, etc.).

In addition to such information, the NEWCP will also provide the CCS with certain tactical evaluations and assessments it may have made. Such evaluations and assessments will be based upon EW specific knowledge that would not otherwise be available to the CCS.

An example of such an assessment involves an inference on the part of the NEWCP that a missile launch might be imminent. Such an inference may be based upon the observation and subsequent analysis of a brief illuminating signal received from a targeting radar. This assessment clearly has command and control implications. However, it may be argued that the knowledge necessary to render it is highly EW specific and it is more appropriate for the NEWCP to perform such evaluations.

- Effectiveness Assessments

The NEWCP will provide the CCS with evaluations that have been made concerning the outcome of EW engagements. These evaluations may possibly be qualified by a measurement of uncertainty.

- Constraint Requests

The NEWCP will have the capability of requesting that the CCS impose certain constraints upon the use of ship resources. Such requests will be made in order to optimize EW deployments. For example, the NEWCP may request that a particular radar be silenced or that the radar not transmit at a certain frequency.

A specific CPF example of the need for such constraint requests involves the use of <CLASSIFIED - see page 4-55 of AH SCSS document>.

The types of constraints that may be requested may be categorized as follows:

- Spatial;
- Spectral;
- Temporal; and
- Asset Utilization.

- Manoeuvre Requests

Certain EW actions undertaken by the NEWCP might require a change in direction of the ship (e.g. deployment of distraction chaff). Requests for such maneuvers need to be forwarded to the CCS.

4 PERFORMANCE CRITERIA

In this section, an attempt will be made to provide performance criteria for the NEWCP. These criteria serve to specify the performance required from the system and are largely driven by the characteristics of the combat environment, in particular the characteristics of the threat.

The performance criteria serve to characterize the NEWCP at different levels of description: some performance criteria will be meaningful only at a system (or holistic) level while others will be meaningful only at lower levels of abstraction of NEWCP functionality. For example, a performance criteria dealing with ship survivability describes NEWCP performance at a high level while a performance criteria dealing with the conservation of chaff rounds describes the NEWCP at a much lower level.

Some performance criteria will fall into one of the following general categories that might also serve as performance criteria for a variety of systems:

- accuracy;
- correct reasoning;
- speed; and
- completeness.

By contrast, some NEWCP performance criteria will be highly specific and meaningful only within the context of the NEWCP. An example of such a criterion is the requirement that the NEWCP must be able to deal with saturation attacks wherein CLASSIFIED missiles arrive at the ship over a time interval of CLASSIFIED seconds.

While some of the performance criteria, such as those related to correct reasoning and completeness, may seem somewhat vague, they do serve a useful purpose. Even if one cannot rigorously quantify the degree to which an algorithm implements "correct reasoning", it remains important that this issue be addressed within the context of a formal plan to test the NEWCP.

Some of these performance criteria may seem difficult to test for (e.g. effectiveness assessment accuracy) without building an actual NEWCP. In this regard, computer simulation may play an important role in NEWCP performance testing.

P1 CPF Survivability

The NEWCP shall contribute to ensuring that the survivability of the CPF (defined in terms of its probability of completing the engagement without sustaining a single hit) will exceed TBD within the context of the medium range threat scenario (Ref A.) and TBD within the context of the long range threat scenario.

P2 Threat Specific Probability of Softkill

In conjunction with performance requirement P1, the NEWCP will have the following threat-specific probabilities of not sustaining a missile hit:

Harpoon:	TBD
SS-N-22:	TBD
SS-19:	TBD
AS-6:	TBD

P3 Overall NEWCP Reaction Time

The threat scenarios enumerated in Ref. A, confer an upper boundary upon the time available to defeat missile threats through the use of EW (as measured from the event = missile launch). The threat scenarios involve 4 different missile types. The maximum flight times (approximate) for each of these 4 threats are provided as follows:

Harpoon:	X minutes
SS-N-22:	X minutes
SS-19:	X minutes
AS-6:	X minutes

P4 NEWCP Reaction Time From Threat Active Radar Turn-on

A significant event associated with an attack by missiles equipped with active radar is the activation of the threat's seeker. Although the NEWCP has the capability to detect / infer the presence of a missile prior to seeker activation, the seeker activation is an event that can be significantly exploited by the NEWCP.

Accordingly, it is useful to provide an indication of the time between threat seeker activation and expected missile impact. Much NEWCP processing may be required between seeker activation and impact; therefore the magnitude of these time intervals are very important driving factors for NEWCP performance in the domain of response time.

The threat scenarios enumerated at Ref A. provide 3 types of missiles with active radars. Based on these scenarios, the NEWCP has, for each type of missile, the following amount of time to perform EW activities from the moment of seeker activation:

Harpoon:	X
SS-N-22:	X
SS-N-19:	X
AS-6:	N/A

P5 Threat Loading

Based on threat scenarios enumerated in Ref A., the NEWCP will have the capability to successfully prosecute (using EW) X threats that all arrive at the ship within a time interval ≈ X s.

P6 Speed - Response Time to Passive Missile

The passive missile defined in the representative threat scenario has a total flight time of X minutes. Within this time interval the NEWCP must be capable of defeating this threat.

P7 Threat Radar Types

The NEWCP must be capable of successful EW prosecution of threats with the radar characteristics of the missiles identified in the following list. Included with each threat identified is a reference to a table in Ref A. This table provides amplifying detail concerning radar parameters:

- Harpoon (Table 8);
- SS-N-22 (Table 10);
- SS-N-19 (Table 12);
- AS-6 (Table 14 - targeting radar); and
  (Table 15 - passive seeker).

P8 Threat Kinematics

The NEWCP must be capable of successfully engaging a HARPOON missile that has kinematics attributes as provided in Table 9 of Ref A.

The NEWCP must be capable of successfully engaging an SS-N-22 missile that has kinematics attributes as provided in Table 11 of Ref A.

The NEWCP must be capable of successfully engaging an SS-N-19 missile that has kinematics attributes as provided in Table 13 of Ref A.

The NEWCP must be capable of successfully engaging an AS-6 missile that has kinematics attributes as provided in Table 16 of Ref A.

P9 Threat Trajectories

The NEWCP must be capable of successfully engaging a HARPOON missile that follows a sea skimming flight profile as provided in Figure 14 of Ref A.

The NEWCP must be capable of successfully engaging an SS-N-22 missile that follows a sea skimming flight profile as provided in Figure 15 of Ref A.

The NEWCP must be capable of successfully engaging an SS-N-19 missile that follows a sea skimming flight profile as provided in Figure 16 of Ref A.

The NEWCP must be capable of successfully engaging an AS-6 missile that follows a sea skimming flight profile as provided in Figure 17 of Ref A.

P10 Threat Launch Ranges

The NEWCP must be capable of prosecuting threats that are launched at the ranges provided in sections 5.5.1 and 5.5.2 of Ref A (e.g. launch ranges from X km to X km.

P11 Threat Point of Origin

The NEWCP must be capable of prosecuting threats that originate from subsurface, surface, and air environments.

P12 Accuracy - Effectiveness Assessment

The result of the effectiveness assessment will be correct TBD % of the time.

P13 Speed - Effectiveness Assessment

The effectiveness assessment will be completed within TBD seconds of countermeasure deployment.

P14 Completeness - Effectiveness Assessment

The effectiveness assessment algorithm will make use of threat kinematics information and threat emissions information. Furthermore, the effectiveness assessment will be based upon the specific goal of the EW countermeasure employed as well as upon any knowledge of the threat characteristics.

P15 Accuracy - Threat Prioritization

The threat ranking produced by the CCS and the NEWCP, within the context of the 2 defined threat scenarios enumerated in Ref A, will be consistent with that provided by a human expert in the field of naval tactical AAW.

P16 Speed - Threat Prioritization

As threats move through space and undergo other changes (e.g. threat radar switches from search to track), the relative priority of threats change. Within this context, it is meaningful to address the issue of how "stale" the current threat priority list is with respect to reality. In this regard, the NEWCP contribution to threat priority

ranking will be updated no more slowly than once every TBD seconds.

P17 Completeness - Attack Anticipation

The NEWCP will take advantage of all combat environment cues that may indicate that an attack is imminent. Examples of such cues include:

- Cues provided by the CCS (e.g. based on acoustic contacts);
- Detection of targeting radar; and
- Detection of radar altimeter.

P18 Fratricide Reduction

The performance of the NEWCP will be such that the likelihood of a fratricide event occurring will be < TBD.

P19 Completeness - Fratricide

The NEWCP will consider all friendly assets (e.g. naval platforms, air platforms) when attempting, in collaboration with the CCS, to predict / minimize fratricide events.

P20 Resource Conservation

The NEWCP will manage CPF EW expendables in such a way as to ensure that sufficient resources will be available for future engagements. (The expected number of future engagements expected, prior to restocking, is by necessity an estimate that will be based on a variety of factors.

P21 Interference (RAMSES - Radars, CANEWS)

The NEWCP will, collaboratively with the CCS, manage resources in such a way as to eliminate, if possible, spectral interference between the RAMSES jammer and CPF sensors including radars and the CANEWS ESM system.

P22 Interference (RAMSES - COMMS)

The NEWCP will, collaboratively with the CCS, manage resources in such a way as to eliminate, if possible, spectral interference between the RAMSES jammer and CPF communications systems such as the SATCOM system.

P23 ECM - ECM Spatial Interference

The NEWCP will deploy ECM assets in such a manner as to ensure that the likelihood of spatial interference between ECM assets is less than TBD %.

P24 Correct Reasoning - Resource Conflict Resolution

The NEWCP will manage ECM resources in such a manner as to ensure that ECM resources are preferentially used against higher priority threats.

P25 Speed - Response to CCS Request for Specific EW Response

The NEWCP will initiate deployment of EW weapon use, as ordered by the CCS (possibly in support of coordinated hardkill / softkill engagement) within TBD seconds of the receipt of such a designation.

P26 Speed - Provision of Data to the CCS

The latency time associated with the provision of data (e.g. effectiveness assessment data) to the CCS will be less than TBD seconds.

P27 Completeness - Generation of Tactical Picture

When generating a tactical picture (in conjunction with the CCS), the NEWCP will include the following (as a minimum) elements of the combat environment:

- threat missiles;
- hostile air platforms;
- hostile naval platforms;
- friendly air platforms;
- friendly naval platforms; and
- EW assets deployed in the environment

P28 Accuracy - Tactical Situation Assessment

The tactical situation assessments (e.g. tactical interpretations made based on the disposition of hostile and friendly forces in the combat environment) produced by the NEWCP (in conjunction with the CCS), within the context of the 2 defined threat scenarios enumerated in Ref A, will be consistent with those provided by a human expert in the field of naval tactical AAW.

P29 Speed - Tactical Situation Assessment

As the individual elements of the combat environment move through space as well as undergo other changes (e.g. threat radar switches from search to track), the tactical situation changes. Within this context, it is meaningful to address the issue of how "stale" the tactical situation assessment, currently held by or made available to the NEWCP, is with respect to reality. In this regard, the NEWCP (in conjunction with the CCS) will update its tactical situation assessment no slower than once every TBD seconds.

P30 Completeness - Application of Constraints

The NEWCP will apply all relevant (TBD) spatial, temporal, and spectral constraints to the execution of its ECM deployment and effectiveness assessment activities.

P31 Speed - Effectiveness Prediction

The time overhead associated with generating a prediction of the effectiveness of an individual ECM option will be less than TBD seconds. Similarly, the time overhead associated with generating a prediction of the effectiveness of the complete EW battle plan (i.e. the integrated effect of all ECM towards the goal of maximizing ship survivability) will be less than TBD seconds.

P32 Completeness - Sensor Cuing

The NEWCP will have the capability of requesting that the CCS cue the following CPF sensors (depending upon whether they can be cued or modified in order to support cueing):

- SPS-49;
- Sea Giraffe;
- STIR;
- CIWS search and track radars;
- CANEWS; and
- RAMSES.

P33 Speed - Sensor Cueing

The NEWCP will forward a sensor cue request to the CCS within TBD seconds of the generation of the cue request.

P34 Speed - Uncertainty Management

The time overhead associated with uncertainty management processing will be such as not increase overall NEWCP response time by a multiplicative factor exceeding TBD.

P35 Accuracy - Uncertainty Management

Measures of certainty (associated with data and assessments) will propagate, when such data / assessments are used to derive new data / assessments, in a manner consistent with a particular paradigm(s) for uncertainty management (e.g. Dempster - Shafer).

P36 Speed - Operator Input Support

The NEWCP will begin to implement operator entered commands within TBD seconds of the entry of such commands by the operator.

P37 Operator Visibility into NEWCP Operations

The NEWCP will provide the operator with suitable information in order to provide him / her with visibility into NEWCP operations.

P38 Accuracy - Synergistic Deployment of ECM

The NEWCP will deploy multiple ECM assets (e.g. RGPO and Chaff) together in a coordinated and synergistic manner to defeat a particular threat. The synergistic deployment of ECM assets must be consistent with principles provided by a human expert.

P39 Speed - Modification to Countermeasure Currently Underway

Within the context of an NEWCP capability to modify EW deployments that are already underway, the time overhead associated with implementing such modifications will be < TBD s.

P40 Accuracy - Modification to Countermeasure Currently Underway

Any modification to an ECM reaction that is already underway must be consistent with principles provided by a human expert.

P41 Accuracy - Target Identification

The NEWCP will, collaboratively with the CCS, produce target identifications, within the context of the threat scenarios described at Ref. A., that are correct TBD percent of the time.

P42 Speed - Target Identification

The latency time associated with generating an target identification (as performed collaboratively by the NEWCP and the CCS) will be less than TBD seconds.

P43 Trajectory Changes

The NEWCP will, possibly using some data supplied by the CCS, have the capability of detecting changes in the direction of travel (heading) of the threat as small as TBD°.

P44 **Speed - Threat "Lost" / "Kill" Status**

The time overhead associated with the determination, by the NEWCP, that a threat "lost" or threat "kill" condition (as used in the context of EW engagements) exists will not exceed TBD s.

P45 **Accuracy - Threat "Lost" / "Kill" Status**

The NEWCP algorithm that determines whether a target "kill" or target "lost" event has occurred will correctly identify such an event TBD % of the time. The likelihood that an erroneous target "kill" or a target "lost" will be declared will be less than TBD.

P46 **Speed - Jog Detection**

The time overhead associated with the determination that a threat seeker has undergone a "jog" (as used in the context of EW engagements) exists will not exceed TBD s.

P47 **Accuracy - Jog Detection**

The NEWCP algorithm that determines whether a true threat seeker jog has occurred will correctly identify a true seeker jog TBD % of the time. The likelihood that a jog will be declared in the absence of a true jog will be less than TBD %.

P48 **Speed - Detection of Radar State Transition**

The time overhead associated with the determination that a threat seeker has undergone a change of radar state (e.g. from track to search) exists will not exceed TBD s.

P49 **Accuracy - Detection of Radar State Transition**

The NEWCP algorithm that determines whether a radar state transition has occurred will correctly identify a true radar state transition TBD % of the time. The likelihood that a radar state transition will be declared in the absence of a true radar state transition will be less than TBD %.

P50 **Correct Reasoning - Application of Avoidance Tactic**

The NEWCP will implement an avoidance ECM response under the conditions deemed appropriate by a human expert.

P51 **Correct Reasoning - Application of Confusion Tactic**

The NEWCP will implement a confusion ECM response under the conditions deemed appropriate by a human expert.

P52 **Correct Reasoning - Application of Dilution Tactic**

The NEWCP will implement a dilution ECM response under the conditions deemed appropriate by a human expert.

P53 **Correct Reasoning - Application of Seduction Tactic**

The NEWCP will implement a seduction ECM response under the conditions deemed appropriate by a human expert.

P54 **Minimum Miss Distance**

When executing an EW countermeasure whose purpose is to introduce a miss distance between a threat missile and the CPF, a minimum miss distance of TBD m is required.

P55 **Accuracy - Threat Position Determination**

The NEWCP, in collaboration with the CCS, will generate a positional characterization of the threat that is accurate to within ± TBD m (when expressed in rectangular coordinates).

P56 **Accuracy - Threat Emissions Characterization**

There are TBD requirements for the NEWCP to generate threat emissions characterizations within a TBD level of accuracy (e.g. NEWCP will know threat PRF to within 1 % of its true value).

P57 **Accuracy - Force Asset Positional Characterization**

The NEWCP, in collaboration with the CCS, will generate a positional characterization of Force assets that is accurate to within ± TBD m (when expressed in rectangular coordinates).

P58 **Accuracy - Force Asset Emissions Characterization**

There are TBD requirements for the NEWCP to generate emissions characterizations of Force assets within a TBD level of accuracy (e.g. NEWCP will know frequency of surveillance radar to within 1 % of its true value).

P59 **Accuracy - ECM Asset Positional Determination**

The NEWCP will, possibly in collaboration with the CCS, generate a positional determination of CPF ECM assets that is accurate to within ± TBD m (when expressed in rectangular coordinates).

P60 **Completeness - Threat Attributes Used in the Generation of an ECM Response**

When generating ECM options, the NEWCP will use all available information concerning threat characteristics and attributes:

- IR signature;
- EM signature (e.g. PRI, frequency, etc);
- Trajectory (including manoeuvres);
- Low observables;
- EPM; and
- WARM modes.

Note that some of this information may be provided to the NEWCP by the CCS.

P61 **Accuracy - False Targets**

The probability that the NEWCP will declare a false target (e.g. chaff cloud echo, multipath effects, etc.) will be less than TBD.

P62 **Accuracy - Discrimination of Threat Manoeuvre**

The NEWCP will correctly discriminate between a pre-programmed threat manoeuvre and a threat manoeuvre attributable to the effects of EW TBD % of the time.

P63 **Completeness - Sensor Use**

The NEWCP will have the capability of using, for a variety of tactical purposes, information from the following CPF (as well as friendly non-CPF) sensors:

- CANEWS ESM;
- RAMSES ESM;
- SPS-49 Long Range Radar;
- Sea Giraffe Medium Range Radar;
- 2 x STIR Fire Control Radars;
- CIWS Search and Track Radars;
- Hull Mounted Sonar;
- Sonobuoy Processing System;
- Friendly Satellites; and

- Friendly EWACS assets.

Note that some of this information may be provided to the NEWCP by the CCS.

P64 Speed - Sensor Data Fusion

The Sensor Data Fusion function will provide a characterization of a target (kinematics and classification) within TBD seconds of the receipt of track information from multiple sensors. In other words, there is a latency associated with the execution of the Sensor Data Fusion function. Note: Whether sensor data fusion is performed by the CCS, NEWCP, or both remains as an important issue to be resolved.

P65 Speed - Latency of Sensor Data

The CPF and non-CPF sensor data (or track data) received by the NEWCP (e.g. Sea Giraffe data, SATCOM data) will be stale by no more than TBD s. (This is strictly speaking a requirement on the entire combat system, not the NEWCP alone).

P66 NEWCP Performance in the Presence of EPM

The NEWCP will provide effective EW countermeasures in the presence of threat EPM capabilities as described in detail in Ref A.

UNCLASSIFIED

SECURITY CLASSIFICATION OF FORM
(highest classification of Title, Abstract, Keywords)

DOCUMENT CONTROL DATA

(Security classification of title, body of abstract and indexing annotation must be entered when the overall document is classified)

1 ORIGINATOR (the name and address of the organization preparing the document Organizations for whom the document was prepared, e.g. Establishment sponsoring a contractor's report, or tasking agency, are entered in section 8.)

Lockheed Canada
3001 Solandt Road
Kanata, Ontario K2K 2M8

2. SECURITY CLASSIFICATION (overall security classification of the document, including special warning terms if applicable)

UNCLASSIFIED

3. TITLE (the complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S,C or U) in parentheses after the title.)

The Integration of EW Assets on Maritime Platforms - Phase I - Preliminary Functional Requirements Specification (U)

4. AUTHORS (Last name, first name, middle initial)

Doucet, Keith (Lockheed Canada)

Herbst, Andrew (Thomson CSF)

5 DATE OF PUBLICATION (month and year of publication of document)	6a NO. OF PAGES (total containing information. Include Annexes, Appendices, etc.)	6b NO OF REFS (total cited in document)
Nov 1993	46	0

7. DESCRIPTIVE NOTES (the category of the document, e.g. technical report, technical note or memorandum. If appropriate, enter the type of report, e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered.)

Contractor Report

8. SPONSORING ACTIVITY (the name of the department project office or laboratory sponsoring the research and development. Include the address.)

Defence Research Establishment Ottawa
National Defence
Ottawa, Ontario K1A 0Z4

9a. PROJECT OR GRANT NO. (if appropriate, the applicable research and development project or grant number under which the document was written. Please specify whether project or grant)	9b CONTRACT NO (if appropriate, the applicable number under which the document was written)
1AE16	W7714-2-9616

10a ORIGINATOR'S DOCUMENT NUMBER (the official document number by which the document is identified by the originating activity. This number must be unique to this document.)	10b. OTHER DOCUMENT NOS. (Any other numbers which may be assigned this document either by the originator or by the sponsor)
DREO CONTRACTOR REPORT 92-2000-034	

11. DOCUMENT AVAILABILITY (any limitations on further dissemination of the document, other than those imposed by security classification)

(X) Unlimited distribution
( ) Distribution limited to defence departments and defence contractors; further distribution only as approved
( ) Distribution limited to defence departments and Canadian defence contractors, further distribution only as approved
( ) Distribution limited to government departments and agencies; further distribution only as approved
( ) Distribution limited to defence departments, further distribution only as approved
( ) Other (please specify):

12. DOCUMENT ANNOUNCEMENT (any limitation to the bibliographic announcement of this document. This will normally correspond to the Document Availability (11). However, where further distribution (beyond the audience specified in 11) is possible, a wider announcement audience may be selected.)

Full Unlimited Announcement

13. ABSTRACT (a brief and factual summary of the document. It may also appear elsewhere in the body of the document itself. It is highly desirable that the abstract of classified documents be unclassified. Each paragraph of the abstract shall begin with an indication of the security classification of the information in the paragraph (unless the document itself is unclassified) represented as (S), (C), or (U) It is not necessary to include here abstracts in both official languages unless the text is bilingual)

The purpose of this document is to provide a set of functional requirements and related requirements for the Naval Electronic Warfare Control Processor (NEWCP). Prior to the provision of actual requirements, fundamental goal(s) of the NEWCP are identified. These goals help to bound the problem of generating functional requirements.

14 KEYWORDS, DESCRIPTORS or IDENTIFIERS (technically meaningful terms or short phrases that characterize a document and could be helpful in cataloguing the document. They should be selected so that no security classification is required. Identifiers such as equipment model designation, trade name, military project code name, geographic location may also be included. If possible keywords should be selected from a published thesaurus. e.g. Thesaurus of Engineering and Scientific Terms (TEST) and that thesaurus-identified. If it is not possible to select indexing terms which are Unclassified, the classification of each should be indicated as with the title.)

Countermeasures
ECM
Electronic Countermeasures
Electronic Warfare
EW
Integration

5140 88